

S11154-201CT

## Reduced color temperature errors

The S11154-201CT is a photo IC diode with spectral response characteristics that closely resemble human eye sensitivity. Two active areas are formed on the same chip, and the outputs of the two active areas are subtracted from each other by the current amplifier circuit, in order to have sensitivity almost only in the visible range and reduce the color temperature errors.

### Features

- Spectral response close to human eye sensitivity
- Reduced color temperature error
- Lower output-current variation compared with phototransistors
- Excellent linearity
- Low output deviation by different color temperature light source
- Suitable for lead-free reflow (RoHS compliance)

### Applications

- Energy-saving sensor for large-screen TVs, etc.
- Various types of light level measurement

### Absolute maximum ratings (Ta=25 °C)

| Parameter                     | Symbol           | Condition             | Specification                                     | Unit |
|-------------------------------|------------------|-----------------------|---|------|
| Reverse voltage               | V <sub>R</sub>   |                       | -0.5 to +12                                       | V    |
| Photocurrent                  | I <sub>L</sub>   |                       | 5   | mA   |
| Forward current               | I <sub>F</sub>   |                       | 5   | mA   |
| Power dissipation*1           | P                |                       | 150   | mW   |
| Operating temperature         | T <sub>opr</sub> | No dew condensation*2 | -30 to +80  | °C   |
| Storage temperature           | T <sub>stg</sub> | No dew condensation*2 | -40 to +85  | °C   |
| Reflow soldering conditions*3 | T <sub>sol</sub> |                       | Peak temperature 260 °C max., two times (see P.7) | -    |

\*1: Power dissipation decreases at a rate of 2 mW/°C above Ta=25 °C.

\*2: When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

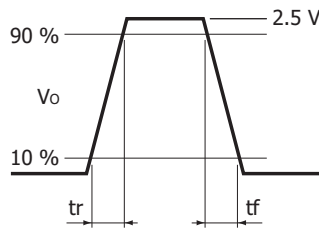
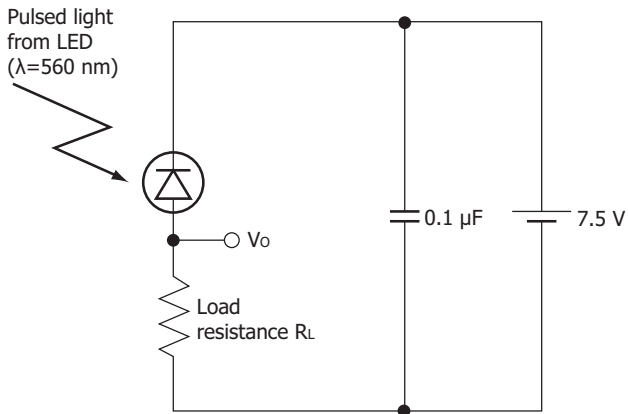
\*3: JEDEC level 3

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

### Electrical and optical characteristics (Ta=25 °C)

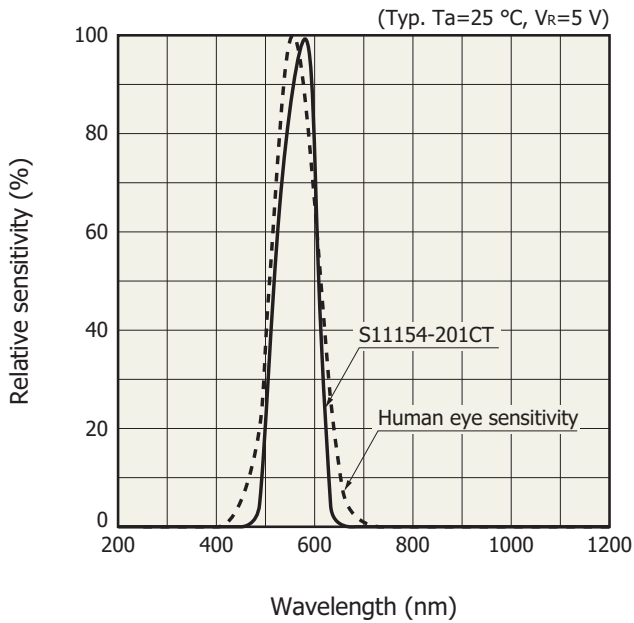
| Parameter                   | Symbol         | Condition                             | Min. | Typ.       | Max. | Unit |
|-----------------------------|----------------|---------------------------------------|------|------------|------|------|
| Spectral response range     | λ              |                                       | -    | 480 to 640 | -    | nm   |
| Peak sensitivity wavelength | λ <sub>p</sub> |                                       | -    | 580        | -    | nm   |
| Dark current                | I <sub>D</sub> | V <sub>R</sub> =5 V                   | -    | 1.0        | 50   | nA   |
| Photocurrent                | I <sub>L</sub> | V <sub>R</sub> =5 V, 2856 K<br>100 lx | 70   | -          | 150  | μA   |
| Rise time*4                 | t <sub>r</sub> | 10 to 90 %, V <sub>R</sub> =7.5 V     | -    | 6.0        | -    | ms   |
| Fall time*4                 | t <sub>f</sub> | R <sub>L</sub> =10 kΩ, λ=560 nm       | -    | 2.5        | -    | ms   |

\*4 Rise/fall time measurement method



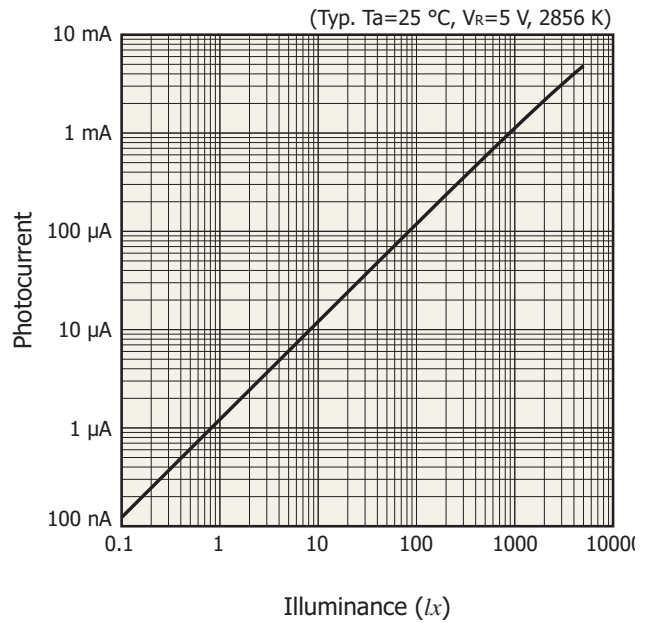
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▣ Spectral response



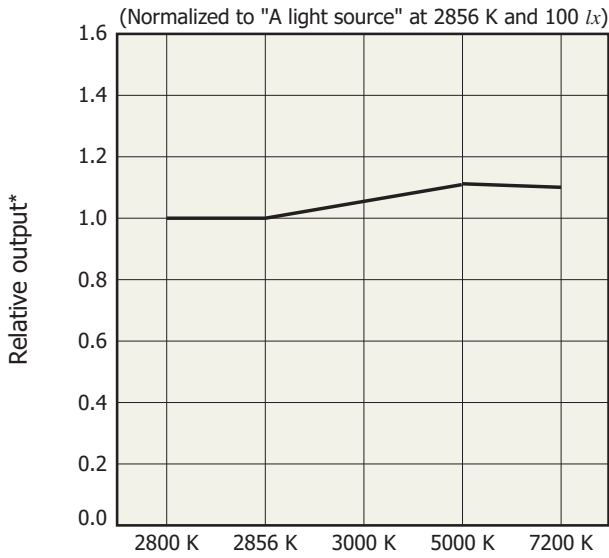
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▣ Photocurrent vs. illuminance



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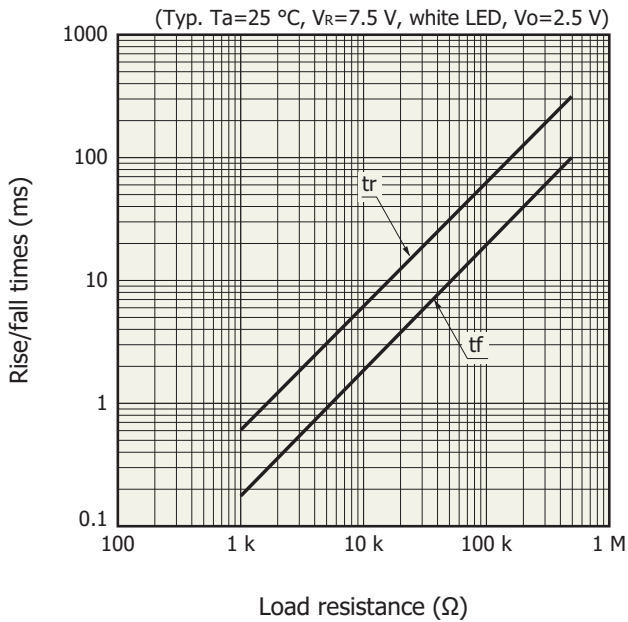
**Color temperature error (difference between various light sources)**



2800 K: Silica bulb  
 2856 K: A light source  
 3000 K: Fluorescent light bulb  
 5000 K: Fluorescent light bulb  
 7200 K: Fluorescent light bulb  
 \* At 2856 K normalized to 100

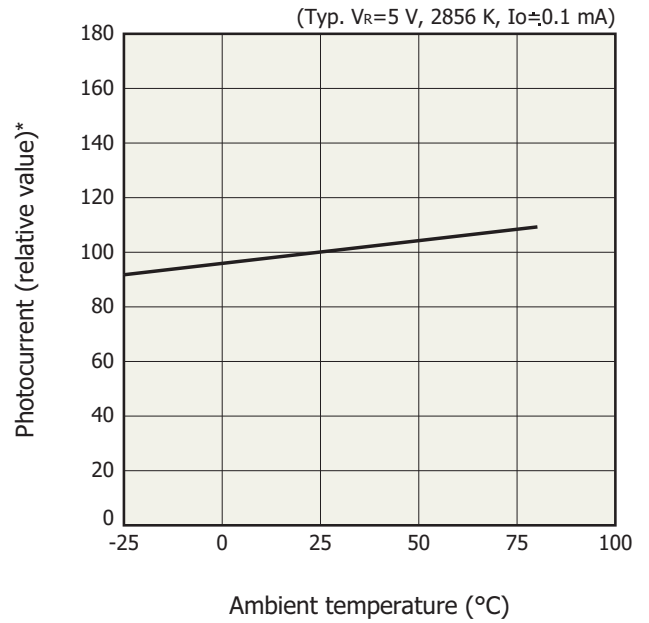
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**Rise/fall times vs. load resistance**



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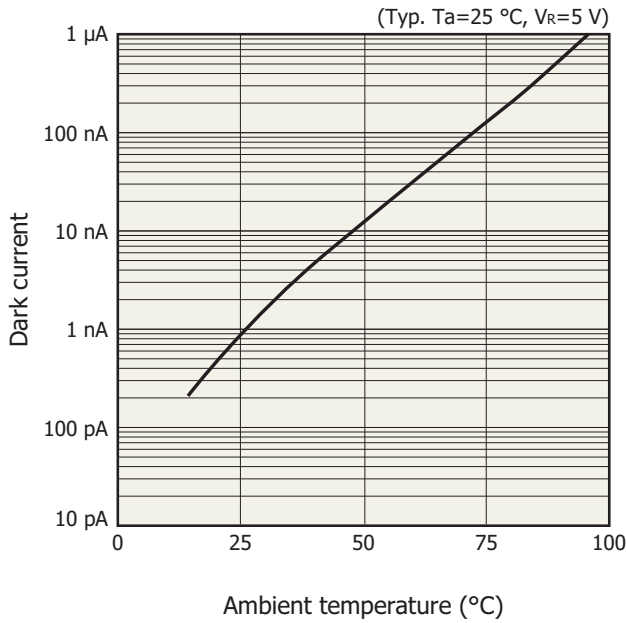
**Photocurrent vs. ambient temperature**



\*At  $T_a=25\text{ }^\circ\text{C}$  normalized to 100.

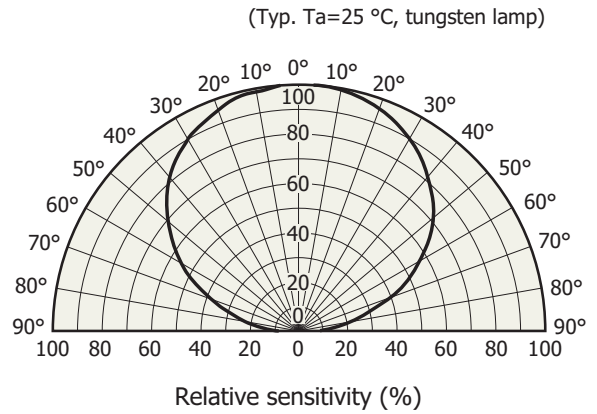
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**Dark current vs. ambient temperature**



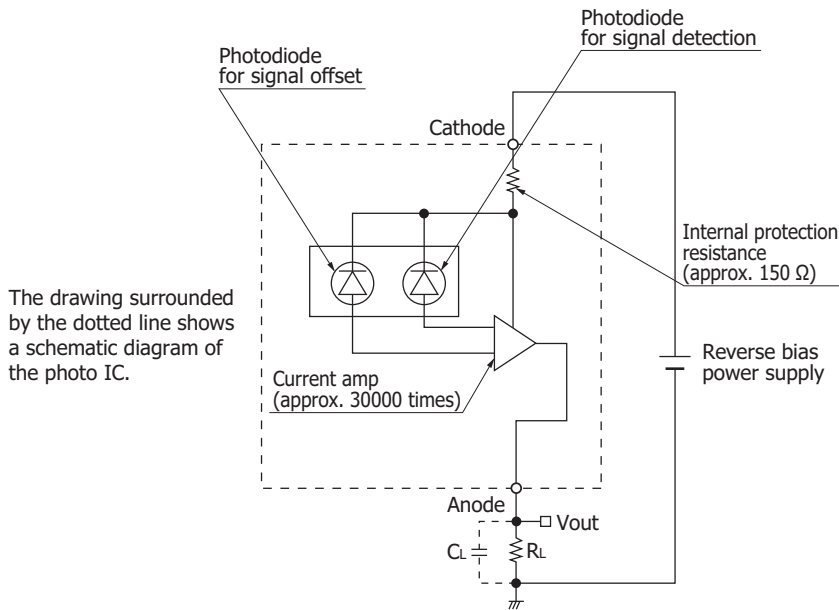
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**Directivity**



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**Block diagram**

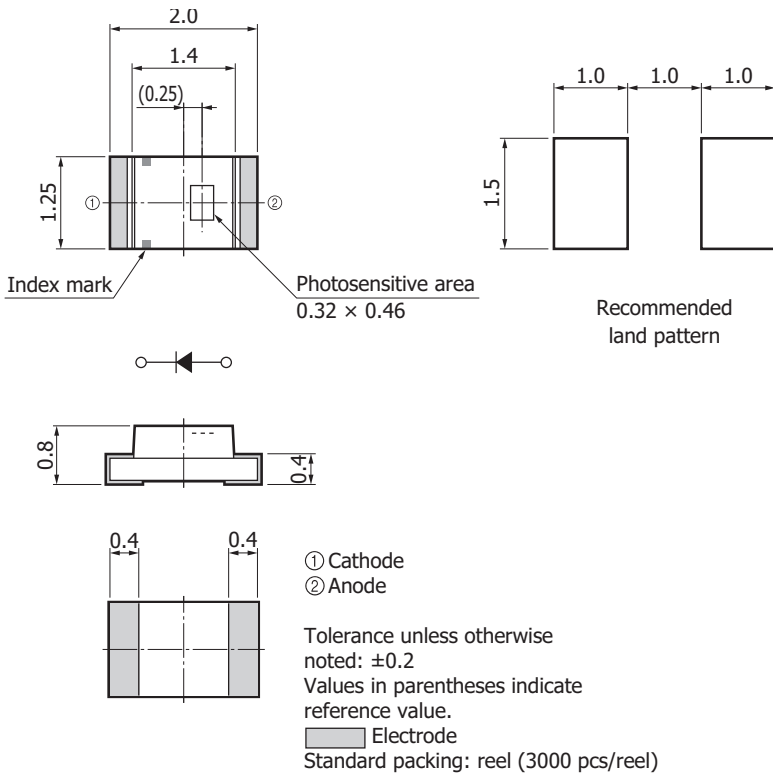


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The photo IC diode must be reverse-biased so that a positive potential is applied to the cathode.  
 To eliminate high-frequency components, we recommend placing a load capacitance  $C_L$  in parallel with load resistance  $R_L$  as a low-pass filter.

$$\text{Cut-off frequency } f_c \approx \frac{1}{2\pi C_L R_L}$$

**Dimensional outline (unit: mm)**



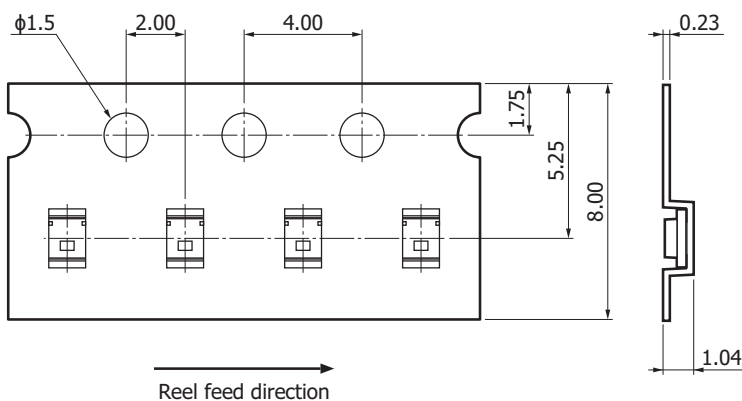
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**Standard packing specifications**

■ Reel (conforms to JEITA ET-7200)

| Dimensions | Hub diameter | Tape width | Material | Electrostatic characteristic |
|------------|--------------|------------|----------|------------------------------|
| 178 mm     | 60 mm        | 8 mm       | PS       | Conductive                   |

■ Embossed tape (unit: mm, material: PS, conductive)



KPIC0234EA

■ Packing quantity

3000 pcs/reel

■ Packing type

Reel and desiccant in moisture-proof packing (vacuum-sealed)

**Operating voltage, output characteristics**

Figure 2 shows the photocurrent vs. reverse voltage characteristics (light source: LED) for the measurement circuit example in Figure 1. The output curves are shown for illuminance levels. The output curves rise from a reverse voltage (rising voltage) of approximately 0.7 V (±10%).

To protect the photo IC diode from excessive current, a 150 Ω (±20%) protection resistor is inserted in the circuit. Reverse voltage  $V_R$  when the photo IC diode is saturated is the sum of  $V_{be(ON)}$  and the voltage drop across the protection resistor  $R_{in}$  [Equation (1)].

$$V_R = V_{be(ON)} + I_L \times R_{in} \dots\dots\dots (1)$$

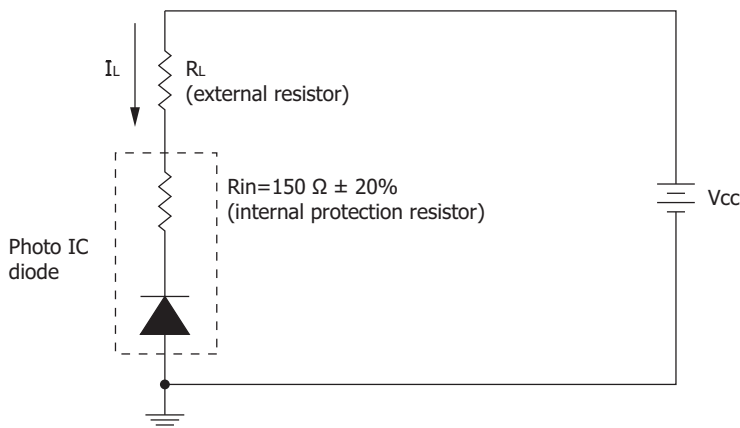
The photodiode's reverse voltage ( $V_R$ ) is expressed by Equation (2) according to the voltage drop across the external resistor. This is indicated as load lines in Figure 2.

$$V_R = V_{CC} - I_L \times R_L \dots\dots\dots (2)$$

In Figure 2, the intersections between the output curves and the load lines are the saturation points. From these points, the maximum detectable light level can be specified. Since the maximum light level is determined by the supply voltage ( $V_{CC}$ ) and load resistance ( $R_L$ ), adjust them according to the operating conditions.

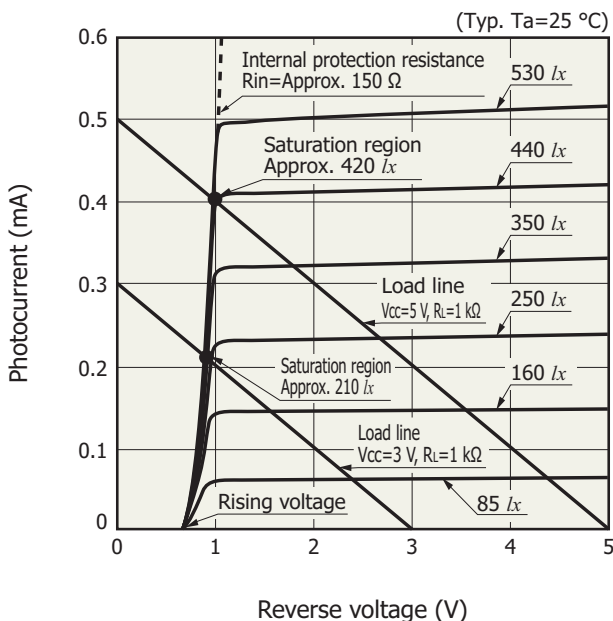
Note: The temperature characteristics of  $V_{be(ON)}$  is approximately -2 mV/°C, and that of the protection resistor is approximately 0.1%/°C.

■ Figure 1 Measurement circuit example



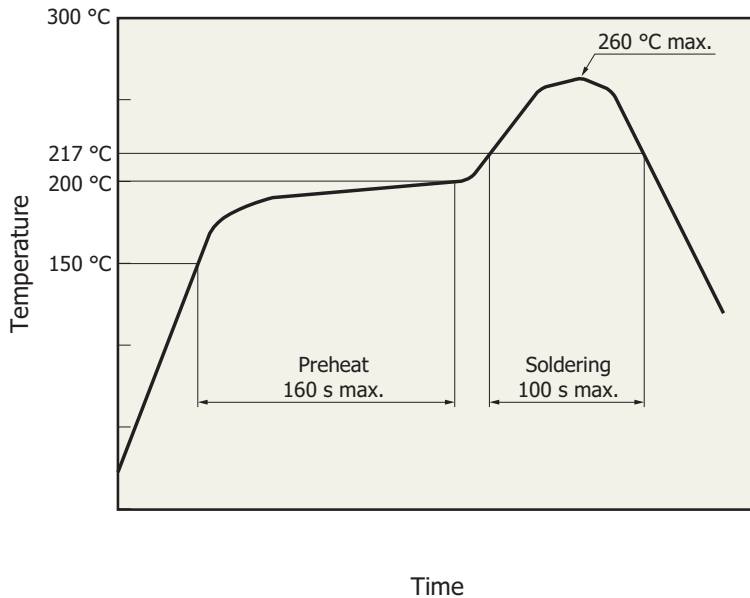
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■ Figure 2 Photocurrent vs. reverse voltage



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

### Example of temperature profile measured with hot-air reflow oven for our product testing



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- This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 168 hours.
- The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. When setting the reflow soldering conditions, check for any problems by testing out the reflow soldering methods in advance.

### Lineup of illuminance sensors

| Type No.     | Type                                  | Output  | Package (mm)                                   | Reverse voltage [Supply voltage] | Spectral response range (nm) | Photocurrent * 2856 K, 100 lx | Rise time (ms) | Photo   |
|--------------|---------------------------------------|---|--|----------------------------------|------------------------------|-------------------------------|----------------|---|
| S9648-200SB  | Photo IC diode                        | Analog current output                                       | $\phi 5 \times 3.5^t$<br>(Top view)            | -0.5 to +12 V                    | 300 to 820                   | 0.26 mA                       | 6              |  |
| S9067-201CT  |                                       |   | $3.2 \times 2.7 \times 1.1^t$<br>COB           |                                  |                              | 0.26 mA                       |                |  |
| S11154-201CT |                                       |   | $2.0 \times 1.25 \times 0.8^t$<br>COB          |                                  | 480 to 640                   | 0.11 mA                       | 6              |  |
| S9705        | Light-to-frequency converter photo IC | Frequency output (for direct connection to microcontroller) | $3.0 \times 4.0 \times 1.3^t$<br>4-pin plastic | [2.7 to 5.5 V]                   | 380 to 640                   | 50 kHz                        | -              |  |

\* S9705: frequency output

### Related information

[www.hamamatsu.com/sp/ssd/doc\\_en.html](http://www.hamamatsu.com/sp/ssd/doc_en.html)

#### Precautions

- Disclaimer

Information described in this material is current as of August, 2015.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

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